Classifying Gaze Data using Hidden Markov Model

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Introduction

- Gaze Data collection is a possibility now.
- Analysis of gaze would help other research problems centered around topics like classification of search activities in a web environment.
- Gaze data is generally classified into three classes: Hard reading, Scanning and Skimming. And have attributes like fixation duration and gaze gradient.

An Example

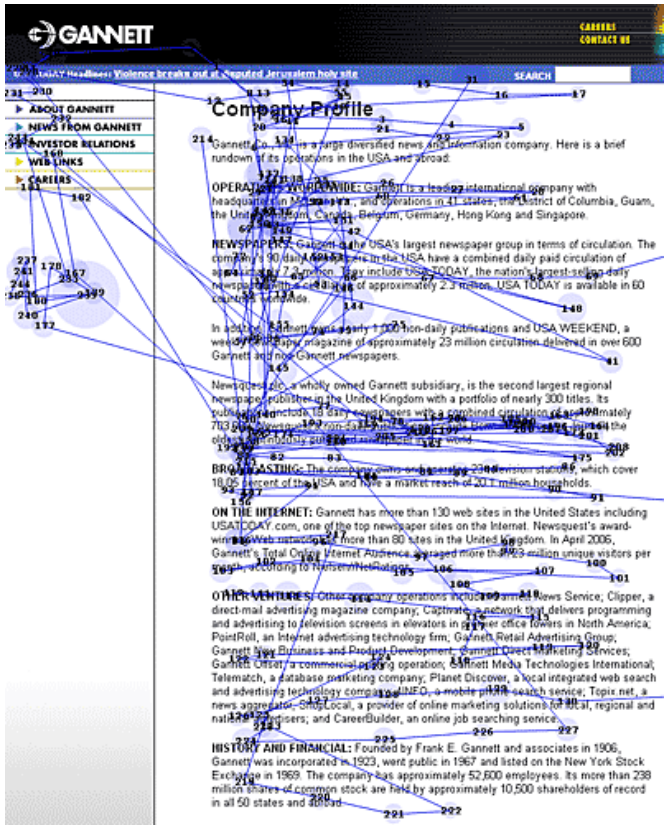

Figure: A mapping of user's attention from an eye-tracking study. Blue dots indicate fixations (the order and duration of their gazes).[1]

Problem Statement

Given the gaze data with attributes like gaze gradient, gaze behaviour etc, classify the reading pattern as hard reading, skimming or scanning.

Data Present

- General Data: ExportDate, ParticipantName, etc.
- Media Data
- Timestamp Data
- Recording Event Data: MouseEvent, KeyPressEvent, etc.
- Gaze event data: GazeEventType, GazeEventDuration, etc.
- Gaze tracking data: GazePointX, GazePointY, etc.
- Eye tracking data: PupilLeft, PupilRight, etc.

Selected Features

- Time-stamp: Times tamps for sampled data and events.
- Eye's motion on screen: Using a gradient function to model motion of gaze data points on screen.
- Gaze Event Type: Data which classifies what kind of reading behaviour was happening. Could be categorized in three classes - Fixation, Saccade and Unclassified.
- Pupil size: Pupil diameter was collected for both eyes.
- Gaze Classification: Each individual's reading pattern was classified by two experts. There are four different types of classification - Reading, Scanning, Skimming and Unknown.

Classifier Used

A Hidden Markov Model (HMM), with following specifications:

- A multidimensional Gaussian distribution for gaze gradient.
- A Gamma function/exponential distribution for pupil size.
- Conditional probabilities for reading behavior.

The classifier will take timestamp, gaze gradient, gaze event type and pupil size as input, to find the classification type of reading, the hidden states.

References

[1] Interesting Facts Make Web Pages Compelling
nngroup.com https://www.nngroup.com/articles/write-interesting-facts/

The End